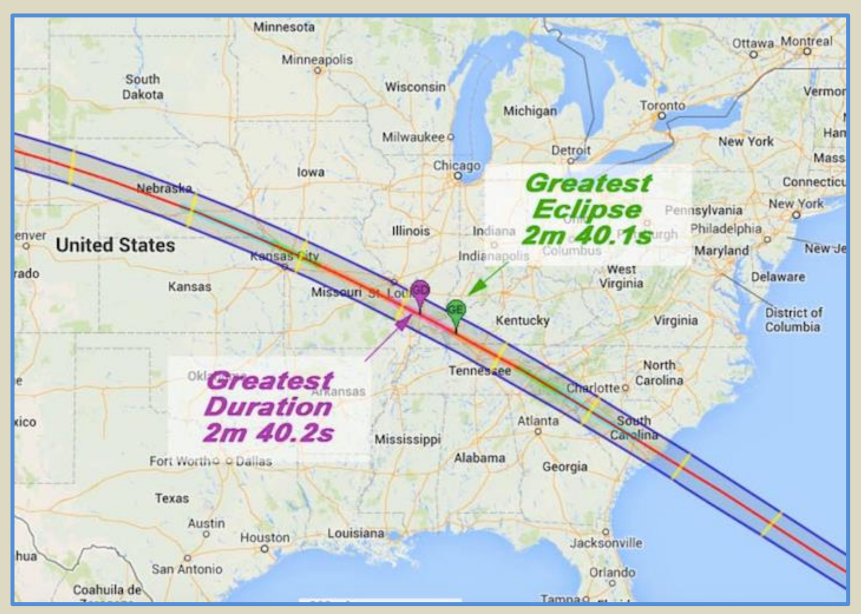
Eclipse 2017: Partnering with NASA/MSFC to Inspire Students

Craig "Ghee" Fry, Mitzi Adams, Dennis Gallagher and Linda Krause, NASA Marshall Space Flight Center

INTRODUCTION

NASA's Marshall Space Flight Center (MSFC) is partnering with the U.S. Space and Rocket Center (USSRC), and Austin Peay State University (APSU) to engage citizen scientists, engineers, and students in science investigations during the 2017 American Solar Eclipse. Investigations will support the Citizen Continental America Telescopic Eclipse (CATE), Ham Radio Science Citizen Investigation (HamSCI), and Interactive NASA Space Physics Ionosphere Radio Experiments (INSPIRE). All planned activities will engage Space Campers and local high school students in the application of the scientific method as they seek to explore a wide range of observations during the eclipse. Where planned experiments touch on current scientific questions, the camper/students will be acting as citizen scientists, participating with researchers from APSU and MSFC. Participants will test their expectations and after the eclipse, share their results, experiences, and conclusions to younger Space Campers at the US Space & Rocket Center.



CATE: Citizen Continental America Telescopic Eclipse

CATE allows volunteers to become involved in research by using standardized equipment to take images of the eclipsed Sun at multiple locations within the path of totality from Oregon to South Carolina.

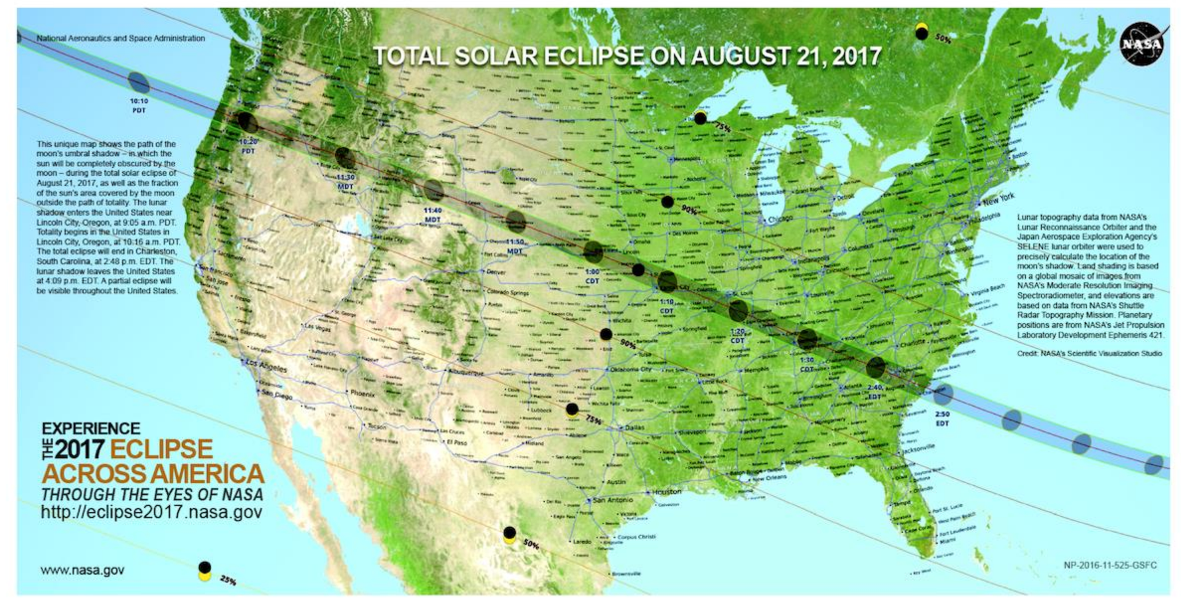
Using CATE, students will:

❑ Set up identical sets of the CATE equipment (Penn, et al., 2016) at our two eclipse viewing locations, Hopkinsville, KY and APSU.

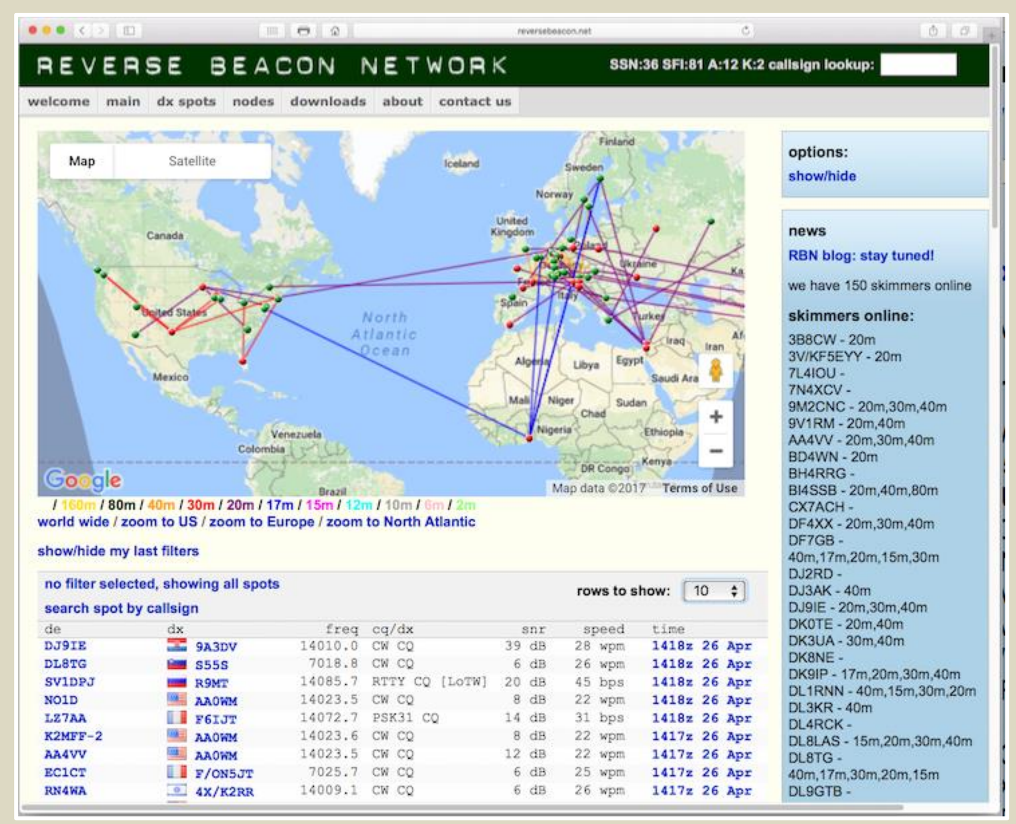
❑ Contribute to the creation of a continuous, 90-minute movie of totality and the solar corona.

❑ Contribute to a detailed study of the inner corona in conjunction with space-based imagery, e.g., SDO (Solar Dynamics Observatory), and SOHO (Solar and Heliophysics Observatory).

Eclipse Across America



Close to location of Greatest Eclipse (Hopkinsville, Kentucky):			
	Start of partial eclipse	16:56 UT	11:56 a.m. CDT
	Start of totality	18:24 UT	1:24 p.m. CDT
	Maximum eclipse	18:25 UT	1:25 p.m. CDT
	End of totality	18:26 UT	1:26 p.m. CDT
	End of partial eclipse	19:51 UT	2:51 p.m. CDT



HamSCI: Ham Radio Science Citizen Investigation

HamSCI (Silver, 2016) activities will focus on developing and operating a reverse beacon to support the Reverse Beacon Network (RBN) that draws from a global collection of automated receiving stations to build a picture of radio propagation conditions (Smith and Silver, 2016; Silver, 2017). RBN has recently demonstrated its scientific utility (Frissell et al, 2015).

Using RBN, students will:

❑ Monitor the high frequency (HF) Amateur Radio frequency bands and collect radio transmission data on the day before, of, and after the eclipse.

❑ Send radio propagation reports ("spots") to central servers where they are immediately displayed and archived.

❑ Build up a continuous record of changing propagation conditions as the moon's shadow marches across the United States.

❑ Access the archived data and assess propagation paths that cross the line of totality at various angles, as well as those along the line to investigate radio propagation changes during the eclipse.

INSPIRE: Interactive NASA Space Physics Ionosphere Radio Experiments

INSPIRE uses the exploration of very low frequency (VLF) natural radio emissions (Story, 1953) in the 0 to 10 KHz band to involve and inspire students of all ages in science and in an exploration of their natural environment. ¬

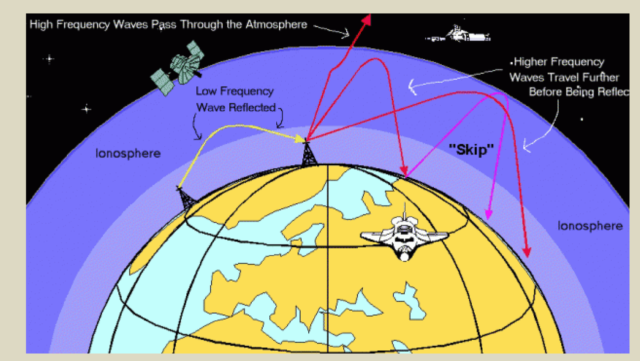
Using INSPIRE, students will:

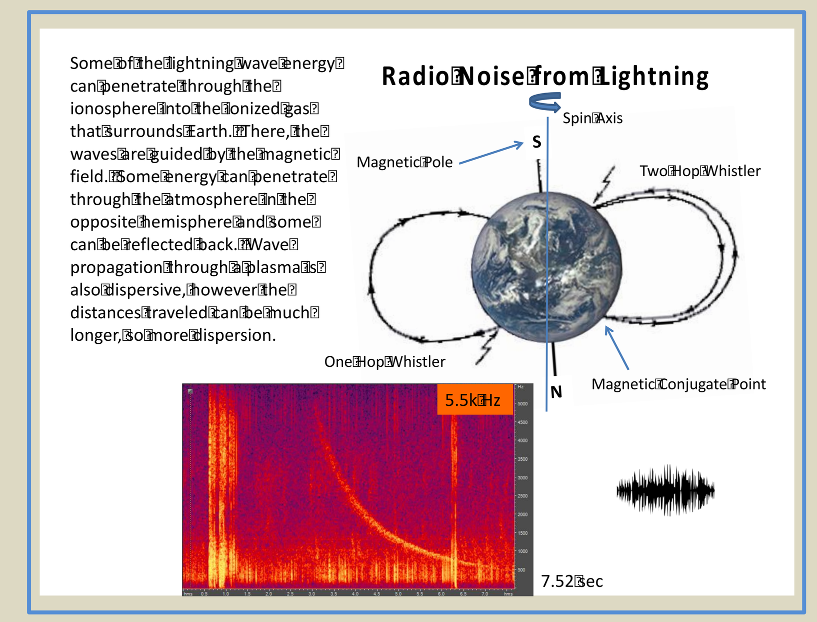
❑ Observe the eclipse through a telescope and broadcast-quality video camera as an outreach activity, to allow for streaming/upload via a MSFC broadcast truck.

❑ Compare their observations to determine whether natural VLF radio noise is influenced by passage of the eclipse shadow.

❑ Analyze VLF radio waves using an INSPIRE receiver near dawn/dusk, and noon/totality before, during, and after the eclipse at our locations.

❑ Characterize the VLF noise during eclipse to see if this radio noise is different at other times of the day without eclipse occurrence.





HamSCI and INSPIRE:

❑ Study the propagation of radio waves that may be influenced by changes in the ionosphere local to the eclipse shadow, and possible persistent effects as the ionosphere recovers to daytime conditions behind the path of totality (e.g., Hurlbert, 1939; Mitra, 1952; Davies, 1990; Frissell et al. 2015).

❑ Investigate the way eclipse radio propagation conditions evolve in a manner similar to day/night transition scenarios that occur at the dawn and dusk terminators (Smith and Silver, 2016).

References

Davies, Kenneth, Ionospheric Radio, Number 31. IET, 1990.
Frissell, N. A., E. S. Miller, S.R. Kaeppler, F. Ceglia, D. Pascoe, N. Sinanis, P. Smith, R. Williams and A. Shovkoplyas (2015), Ionospheric Sounding Using Real-Time Amateur Radio Reporting Networks, Space Weather Quarterly, 12(1), 10-15.
Hulburt, E. O., The E region of the ionosphere during the total solar eclipse of October 1, 1940. Phys, Rev., 55(7):646, 1939.
Mitra, S. K., The Upper Atmosphere. 2d Ed. Monograph series. The Asiatic Society, 1952.
Penn, M. J., R. Baer, R. Bosh, D. Garrison, R. Gelderman, H. Hare, F. Isberner, L. Jensen, S. Kovac, M. McKay, A. Mitchell, M. Pierce, P. Thompson, A. Ursache, J. Varsik, D. Walter, Z. Watson, and D. Young (2016), Instrumentation for the Citizen CATE Experiment: Faroe Islands and Indonesia, Pub. Astr. Soc. Pacific, 129:015005 (7pp), Dec. 2016, DOI:10.1088/1538-3873/129/971/015005.
Silver, W. (2016), HamSCI: Ham Radio Science Citizen Investigation, QST, 101(8), 68-71.
Silver, W. (2017), HamSCI: The Solar Eclipse QSO Party, QST, 102(2), 82-83.
Smith, P. and W. Silver (2016), The Reverse Beacon Network, QST, 101(10), 30-32.
Story, L.R.O. (1953), An investigation of whistling atmospherics, Philos. Trans. Roy. Soc. London Ser. A, 246.